

Notice of Interest

This Notice of Interest concerning the release of a Broad Agency Announcement (BAA) for fiscal year 2007 to solicit research and development (R&D) regarding Nuclear Explosion Monitoring Research and Engineering (NEM R&E) is issued in accordance with 10 CFR 600 and 48 CFR Part 35.016. Proposers should not submit a proposal in response to this Notice of Interest, but may submit a proposal after release of a solicitation at a later date. Solicitation Number: DE-SC52-06NA27305.

Description: The Air Force Research Laboratory (AFRL), the National Nuclear Security Administration (NNSA) and the Army Space and Missile Defense Command (SMDC) will be jointly soliciting proposals for R&D to improve national capabilities to detect, locate, and identify nuclear explosions. It is anticipated that this solicitation will be released on or about March 09, 2006 and closed on or about May 11, 2006 seeking proposals with a period of performance of 1-3 years. The objective of the solicitation will be to advance the state-of-the-art in seismic, hydroacoustic, infrasound and radionuclide methods of nuclear explosion monitoring. This will be achieved through basic and applied research that enhances understanding of the underlying phenomena, proposes new methods of tackling monitoring problems, or develops new data of use in nuclear explosion monitoring. Where appropriate, priority will be given to studies of propagation conditions in Eurasia.

Research products developed under this solicitation shall support Air Force requirements for improving the Nation's capabilities to monitor nuclear explosions. Information about the NNSA Nuclear Explosion Monitoring Research & Engineering (NEM R&E) program integration of research products into operational form for the Air Force can be found online at <https://www.nemre.nnsa.doe.gov/nemre/KnowledgeBase>.

Research is being sought in the following topic areas:

TOPIC 1: Challenges in Seismic Monitoring;

TOPIC 2: Seismic Calibration and Ground Truth Collection;

TOPIC 3: Velocity Models and Synthetic Seismograms

TOPIC 4: Seismic Detection, Location, Discrimination, and Yield Estimation;

TOPIC 5: Infrasound Studies;

TOPIC 6: Hydroacoustic Studies; and

TOPIC 7: Radionuclide Studies.

The objective of this solicitation is to enhance U.S. capabilities in nuclear explosion monitoring primarily with ground-based systems. This will be achieved through advances in the state-of-the-art for nuclear explosion monitoring, basic and applied research that enhances understanding of the underlying phenomena, developing new methods of tackling monitoring problems, or developing new data of use in nuclear explosion monitoring. Field experiments may be proposed.

Each of the topic areas is described below. Individual proposals should be directed to only one topic area, but the Proposer may submit proposals in more than one topic area. All topic areas are of importance. However, depending on the proposals

received and programmatic needs, funding will not necessarily be distributed evenly among the topic areas.

Topic 1 (Challenges in Seismic Monitoring)

Proposals are sought that address the characteristics of small seismic events and the associated seismic signals observed at local (< 200 km) distances. Of particular interest are methods of estimating yield (or equivalent) with uncertainties of a factor of 10 or less for seismic events recorded at local distances (where, for instance, coda may not be available as a stable estimator). The properties of small near surface events are of particular interest, including the variability in local discriminant properties of point explosions, partially coupled explosions, distributed explosions, mine-related stress release, mining activities, shallow earthquakes, and cavity-decoupled explosions; the variation in these discriminant properties with event size over five orders of magnitude; and the variability in and nature of propagation of phases from such events at local distances, including the effect of the weathered zone. Innovative methods of detection appropriate for local events is of interest. Characterization of factors such as tectonic setting or other regional characteristics that affect or determine the characteristics of microseismicity in different locales is also of interest. Systematic studies of all the factors for local events, or as many as practicable, in one or more regions, with delivery of database(s) with appropriate metadata, are desirable. Development of new rugged sensors suitable for portable deployment with observation of the full suite of signals pertinent for local and regional distances is of interest. Proposals are sought on the generation of S waves by partially coupled events relative to tamped events. Combined interpretation of seismic and infrasound signals should be submitted to Topic 5.

Topic 2 (Seismic Calibration and Ground Truth Collection)

Proposals to find events that can be used to calibrate seismic monitoring are sought. For location calibration, proposals for dedicated GT0 calibration explosions are of high interest, especially reciprocal calibration shots. Collection of location ground truth at a GT5 level (absolute location and depth errors less than 5 kilometers) or better is sought for events of magnitude 2.5 and larger. Proposals must specifically address uncertainties in the acquired ground truth information, either by using accepted standards or by proposing credible new methods; research efforts on new methods of acquiring location ground truth will be accepted under this topic. Priority will be given to seismic calibration and ground truth in Eurasia.

Geophysical studies that generate new discrimination ground truth events with source geometry and other characterizing information are sought, such as shallow earthquakes, mining explosions or mining related studies. Calibration of regional coda magnitudes is of interest.

Proposals for development of methods to transfer existing geophysical calibration information (e.g., travel-times, attenuation, etc.) from open seismic stations to new or planned stations and arrays in the monitoring network are of interest. Proposals are sought to estimate geological and geophysical constraints on explosion emplacement conditions in complex areas, especially highly variable regions.

Topic 3 (Velocity Models and Synthetic Seismograms)

Proposals are sought to develop models that calibrate earth velocity and attenuation structure, especially in aseismic regions. As part of this topic there is an interest in new techniques of determining velocity models, such as: tomography; procedures that develop models by fitting multiple datasets; procedures that estimate the

uncertainty of geophysical models and tradeoffs between different parameters of these models, and the resulting uncertainty in observables such as travel times and amplitudes; and studies comparing different methods to find the strengths and weaknesses of each. Improved Q models with emphasis on regional phases Pn, Pg, Sn, Lg and surface waves are desirable. Priority will be given to studies of propagation conditions in Eurasia.

Innovative methods of computing synthetic seismograms for local, regional, and near teleseismic distances are of interest. Some topics of interest are 3D computations in large models, more efficient 2.5D calculations that could be incorporated in other routines (e.g., location), hybrid or approximate methods that have significant advantages over other methods, and methods that calculate spectra or envelopes; or other relevant topics.

Topic 4 (Seismic Detection, Location, Discrimination, and Yield Estimation)

Research proposals to improve seismic detection, location, discrimination, and yield estimation for nuclear explosion monitoring are sought, as detailed below. Tuning studies, either of specific arrays or of techniques in general, are not sought.

New and innovative seismic signal processing methods are sought with potential to significantly lower the thresholds at which detection, location and identification functions can be performed at acceptable false alarm rates. New and innovative methods of array signal processing are solicited that employ calibration or other techniques to enhance signal detection and parameter estimation (e.g., azimuth, phase velocity) in strongly heterogeneous media. Full waveform methods, including waveform matching, for seismic event detection, location, and discrimination are of particular interest, especially studies that assess success and failure rates and the effect of less than perfect matching. Estimating improvements in detection, including testing of detection processes using superposition of actual signals in increasing noise, is of interest.

Improved methods of arrival-time picking and phase identification, including the probability of phase misidentification and the effect on location error, are desired. Improved location techniques are sought; especially development and validation of mathematical and geophysical techniques for determining new ground truth events and earth structure. An example could be combining relative event locations with limited ground truth constraints (such as fault traces).

Proposals for advanced discrimination methods that make significant improvement over current techniques is of interest, as are new techniques of detecting and validating depth phases for crustal events observed locally, regionally and teleseismically. Proposals to extend existing techniques of discrimination such as Ms:mb to lower level regional signals are of interest, as are other possible discriminants using intermediate period data. The influence of source processes on observed seismic data is of interest, as detailed below.

Proposals are sought complementing existing efforts to answer the question of how seismic energy is generated from underground phenomena (including distributed and single point explosions, double-couple earthquakes and other modes of rock failure), how this energy is partitioned between P and S waves, and how it propagates to local (less than 200 km) and regional distances (less than 2,000 km). Generation of S waves from explosions is of interest, as are models of the source, both theoretical and empirical. Also of interest are observational and experimental studies of small shallow earthquakes, especially high stress drop events, such as in mines. In propagation, the influence of 3D laterally varying structure, including laterally varying vertical velocity gradients, and 3D scattering on the stability of propagation of Pn, Pg, Sn, Lg is of interest. New methods of estimating the yield of a fully coupled explosion, and how emplacement conditions affect

the observation are of interest. Proposals for theoretical and observational investigations, including empirical source models and mine investigations will be accepted under this topic.

Topic 5 (Infrasound Studies)

Proposals are sought for an improved understanding of the fundamental physics of generation of infrasound from underground contained and near-surface explosions and other sources, of local and regional propagation of infrasound signals from such sources, and of atmosphere dynamics affecting propagation of such signals.

Proposals are sought on the interpretation of signals from co-located infrasound and seismic sensors at local and regional distances. Phase association, yield estimation and event identification are of particular interest. Other topics include the uncertainty in azimuth and range determinations for infrasound signals from seismic events at local and regional distances; and the maximum infrasound signal expected from an event that does not have a surface component of energy release.

Topic 6 (Hydroacoustic Studies)

Proposals are sought that investigate the physics of long-range hydroacoustic propagation through the Antarctic convergence zone, by hydroacoustic coastline reflection, and through and around blockages. Proposals that investigate the physics of SOFAR channel coupling and long-range propagation of hydroacoustic energy are also sought. Coupling from sources in shallow water and at the air-water interface is of particular interest. Proposals that analyze the full monitoring spectrum (1-100 Hz) with a focus on energy above 30 Hz are desired. Observational, experimental, and theoretical studies are of interest; studies that combine data with theory are of particular interest for potential discrimination of underwater seismic events. Software efforts that produce tools or enhance existing tools for research or operational research will also be considered under this topic.

Topic 7 (Radionuclide Studies)

Proposals are sought to enhance the United State's ability to monitor foreign nuclear tests via improved instrumentation used for the detection of radionuclides indicative of nuclear explosions. The primary areas of interest, which are described in more detail below include: the reliability of components of radionuclide sampling equipment, techniques for calibration of gas sampling equipment, miniaturized beta-gamma coincidence electronics, and the miniaturization of noble gas and particulate collection techniques. Proposals are not sought for meteorological models.

Equipment that can significantly improve the reliability, maintainability and performance of high-resolution gamma-ray spectrometers (HPGe) are sought. Possible areas of research include new or modified techniques to cool large HPGe crystals that have the potential to have high reliability without: degrading detector resolution, requiring significantly more maintenance compared to current commercial electromechanical systems, being costly to manufacture, or that are not consistent with unattended operation (e.g., requiring the use of consumables).

Proposals are also sought to provide calibration for beta-gamma xenon detection systems for existing nuclear explosion monitoring equipment such as the Automated Radioxenon Sampler Analyzer (ARSA) system. Proposals in this area should make use of standard techniques such as those described in the literature, and use radioxenon standards, including isotopes such as $^{133/135}\text{Xe}$ to calibrate existing xenon beta-gamma detection systems, without redesign of the existing equipment. The proposals must

include the possibility to produce and transfer known quantities of radioxenon into a beta-gamma cell and perform calibrations. Techniques are also sought to check the calibration of radioxenon standards created for calibrating xenon detection systems at low levels for $^{133/135}\text{Xe}$. The instrumentation must be capable of separating the stable and radioactive xenon from a sample and measuring the activity concentration to better than 10% at a $^{133/135}\text{Xe}$ concentration of 10 mBq/cc Xe. Techniques to deliver gas standards with very low dead volume, without the use of Hg or other fluids are also desired.

Proposals are sought to miniaturize NEM gas and particle collection and analysis techniques for use on airborne platforms. Miniaturized components such as small, high flow rate compressors and vacuum pumps may allow size reduction. In addition, proposals might seek to perform research on miniaturized techniques such as the use of binary gas analyzers, air scrubbers ($\text{CO}_2/\text{H}_2\text{O}$ removal at 100 liters per minute or higher), or adsorbents such as carbon-based molecular sieves or permselective membranes to selectively collect gases at room temperature.

Proposals are sought to modernize, miniaturize and standardize electronics used for beta-gamma detection systems for use in xenon measuring equipment, without changing the basic operating parameters of the existing beta-gamma detectors. Readout electronics and high-voltage power supplies for the beta/gamma systems can be a weak link in system uptime and reliability. An integrated package that can record 8-12 photomultiplier (PMT) signals with associated time and energy stamping, generate 2-dimensional beta-gamma coincidence histograms along with single PMT signals, as well, is desired. The readout system must record the live-time for each readout channel and allow for independent gain and offset adjustments. In addition, the ability to have user-defined gating and histogramming options is highly desirable. Embedded controllers for source transfer is also a requirement. In tandem with readout electronics, is the need for an 8-12 channel, high stability, high voltage (HV) power supply that can be remotely set and monitored. The readout and power package will need to interface with the existing ARSA computer architecture and is critical for mission compatibility and short turn around times.

*****END OF TOPICS*****

After the solicitation is released, proposals may be submitted for either a contract or a financial assistance award. However, AFRL, NNSA and SMDC reserve the right to determine which procurement instrument shall be used. The instrument shall be appropriate to the scope of work and performing organization. NNSA may issue contracts or financial assistance awards, or both. The Air Force and Army will issue contracts only. If a contract is issued, acquisition regulations apply per 48 CFR, and a cost reimbursement contract is anticipated. If a financial assistance award is used, 10 CFR 600 applies, and a cooperative agreement is anticipated.

The BAA will solicit proposals from all responsible organizations (foreign and domestic) including industry, academic institutions, research institutions, and non-profit organizations. Federal agencies may submit proposals as prime/lead contractors subject to appropriations language but may not partner with Federally Funded Research and Development Centers (FFRDC). FFRDCs, including NNSA national laboratories, cannot directly respond to this solicitation as prime/lead participants. FFRDCs, including NNSA national laboratories, may participate in this solicitation as team members; however, such participation must be consistent with the FFRDCs sponsoring agreement. The FFRDC effort for any proposal, in aggregate, shall not exceed 50% of the total effort of the

project. Information will be provided in the solicitation on how to include FFRDCs such as NNSA national laboratories in this solicitation as team members.

Teaming is encouraged. Teaming that results in facilitating integration of research products into the NNSA Knowledge Base will enhance programmatic value. Teaming that results in training of graduate students (in particular university/industry teams as a way of providing real world problems for Ph.D. candidates to work on) will enhance programmatic value. Programmatic value is one of the selection criteria for proposals. If teaming arrangements are proposed, technical approach, deliverables and costs must be clearly separable for individual team members as the Government reserves the right to award to the team or to individual team members.

The NNSA, AFRL and SMDC each reserve the right to fund, in whole or in part, any, all or none of the proposals and to award without discussions. All awards will have an NNSA Product Integrator (subject matter expert) assigned at the time of award to help ensure maximum value to the US Government of research products successfully transitioning to operations as appropriate.

This Notice of Interest is being issued in advance of passage of fiscal year 2007 appropriations to provide more time for potential proposers to prepare and to allow awards to be made as early as possible within the 2007 fiscal year. The topics in this Notice of Interest represent the maximum set of topics that may appear in the solicitation. The final number of topics and awards, however, are subject to the availability of funds.

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Requiring Activity: The Air Force Research Laboratory (AFRL), the Army Space and Missile Defense Command (SMDC), and the National Nuclear Security Administration (NNSA). Classification Code: A NAICS Code: 541710